WHAT IS CLAIMED IS:

1. A method of making a proton exchange fuel cell electrode, comprising:

forming carbon nanotubes on a substrate, to form a catalyst support;

depositing a precious metal on the nanotubes, to form a carbon nanotube supported catalyst; and

incorporating a polymer membrane into the spaces between the carbon nanotube supported catalyst, to form the electrode.

2. The method of claim 1 wherein said forming comprises forming carbon nanotubes on a gas diffusion layer substrate.

3. The method of claim 1 wherein said forming comprises forming single walled carbon nanotubes.

4. The method of claim 1 wherein said forming comprises forming multi-walled carbon nanotubes.

5. The method of claim 1 wherein said forming comprises preparing an array of anodic porous alumina templates on a substrate before said forming, to form an aligned array of carbon nanotubes.

6. The method of claim 5 comprising preparing an array of anodic porous alumina templates on a porous silicon substrate before said forming, to form an aligned array of carbon nanotubes.

7. The method of claim 1 wherein said forming comprises growing carbon nanotubes on the substrate using a chemical vapor deposition process using acetylene in nitrogen as a carbon source.

8. The method of claim 7 wherein said forming comprises growing boron dopes carbon nanotubes on the substrate using a chemical vapor deposition process using acetylene in nitrogen as a carbon source.

9. The method of claim 1 wherein said forming comprises directly growing carbon nanotubes on a carbon substrate using a chemical vapor deposition process.

10. The method of claim 9 wherein said forming comprises depositing a catalyst selected from the group consisting of cobalt, iron, boron, and combinations thereof, on the carbon substrate, for catalyzing the growing of the carbon nanotubes.

11. The method of claim 10 wherein said depositing cobalt comprises electrodepositing on one side of the carbon substrate by a three-electrode dc method in a 5 wt. % $CoSO_4$ and 2 wt. % H_3BO_3 aqueous solution at 20°C.

12. The method of claim 11 wherein the cobalt loading is between none and 20 mg/m^2.

13. The method of claim 12 wherein the size of the deposited catalyst particles is a function of the catalyst loading, such that an increase in catalyst loading produces larger cobalt particles.

14. The method of claim 10 wherein said forming comprises using a chemical vapor deposition process using acetylene in nitrogen as a carbon source.

15. The method of claim 1 wherein said depositing comprises depositing a metal selected from the group consisting of platinum, gold, other precious metals, and combinations thereof.

16. The method of claim 1 wherein said depositing comprises surface functionalizing the surface of the nanotubes through a chemical oxidation treatment and depositing the precious metal by an incipient-wetness process.

17. The method of claim 1 wherein said depositing comprises an electrodeposition process.

18. The method of claim 17 wherein the electrodeposition process comprises electrodepositing platinum on the nanotubes by a three-electrode dc method in 5 mM H_2PtCl_6 and 0.5 M H_2SO_4 aqueous solution.

19. The method of claim 1 wherein said incorporating a polymer membrane comprises depositing a solubilized perfluorosulfonate ionomer into the spare space between nanotubes to form a 4-phase boundary.

20. The method of claim 1 further comprising forming a proton exchange membrane fuel cell utilizing the formed electrode, comprising:

adding a proton conducting membrane; and

adding electron collectors having fuel flow fields, to form the proton exchange membrane fuel cell.